

Hydraulic Hybrids

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Advanced Technology Division
Office of Transportation and Air Quality
U.S. Environmental Protection Agency

EPA's Goal for Hydraulic Hybrids

1. To demonstrate the ***Best Possible Business Case*** for hybrids to both manufacturers / suppliers and to fleet customers
2. To vividly show that series Hydraulic Hybrids Vehicles (HHV) have ***highest efficiency*** at the ***lowest cost*** potential of any hybrids
3. To definitively show that there are ***no technical barriers*** for series HHVs to become commercially viable

EPA's Full Series Hydraulic Hybrid Urban Delivery Vehicle

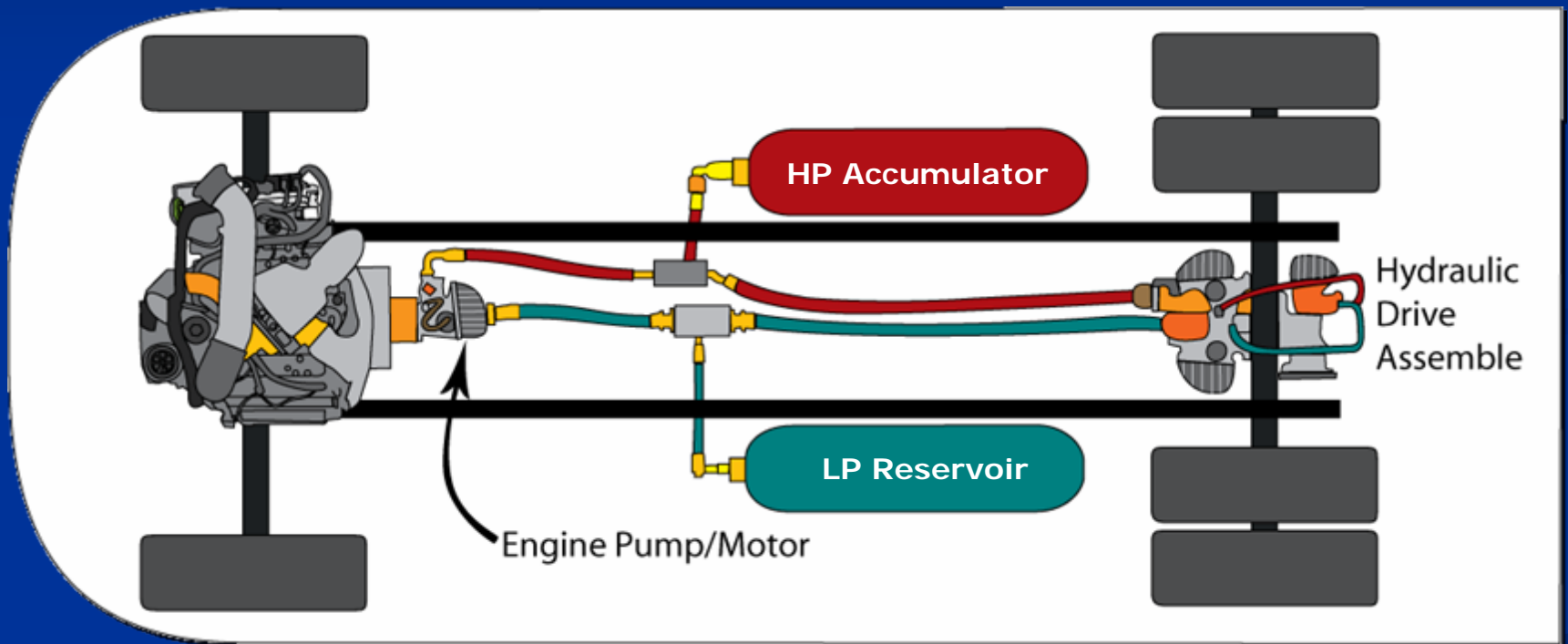
Hydraulic Hybrid UPS Package Car Demonstration Creates "Real World" Experience



- 60-70% mpg improvement in city driving
- 2-3 year payback has attracts attention from fleets
- Potential for net Lifetime savings over \$50,000 with \$2.75/gal fuel costs
- Demonstration to accelerate technology transfer to industry & familiarity with technology
- Partners (UPS, Eaton, International Truck, U.S. Army)

New York Times (Feb 10, 2005) – “The Environmental Protection Agency and the United Parcel Service announce a test project today demonstrating a new type of transmission that could save energy and reduce pollution.”

Full Series Hydraulic Hybrid Configuration*



**Similar to the hydraulic hybrid urban delivery vehicle demonstrated by EPA, UPS, Eaton, International, and U.S. Army in a class 6 UPS truck.*

Status of EPA's Hydraulic Hybrid UPS Package Car

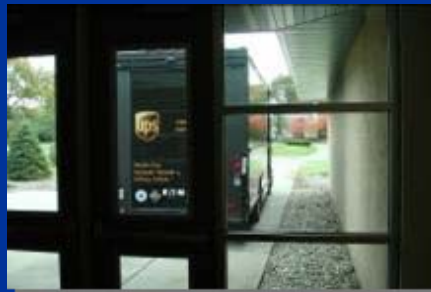


- **Partners** - EPA, UPS, Eaton Corporation, International Truck and Engine Corporation, and U.S. Army
- **Publicly Announced** - June 2006 with 10 subsequent "road show" events through December
- **Great Interest** - Unbelievable industry and public reception to the technology, outstanding media coverage
- **Current Activities Include** – We have installed new power brake and power steering accessories to enable engine-off operation
- **Field Tests** – We began field testing in the Detroit area
- **Next Steps** – Continuation of field tests, and working with our industry partners on planning the next phase of this exciting project.

On-going Field Tests



- Field testing is an important step forward to get these vehicles commercialized
- In-service field tests delivering package began in October 2006
- Field and laboratory tests are still on-going
- The tests are used to calibrate the prototype hybrid and evaluate:
 - ✓ *Fuel economy and emissions*
 - ✓ *Overall vehicle system performance*
 - ✓ *Individual component performance*



General Experiences from Field Tests

- Field testing is different from lab testing
 - ✓ *Baseline routes are different than the test routes*
 - ✓ *Weather, drivers, routes, vehicle weight change each day*
 - ✓ *While it is possible to understand the variations, it is difficult to normalize the results*
 - ✓ *Months of testing are needed to get thorough results*
- Routes traveled were not like the EPA City Cycle (different number of stops, acceleration rates, & average speed)
- Early real-world operation support model predictions that series HHV technology is capable of improving fuel economy by 60-70% in urban driving
- UPS was pleased with how the vehicle performed and with the fuel economy gains demonstrated in these early tests
- We are deferring to UPS to make a formal announcement of specific fuel economy results

Texas Hydraulic Hybrid Project

PACCAR/Eaton/Peterbilt

TERC/HARC

Hydraulic Launch Assist

- This project is moving from the concept phase into the production phase.
- EATON Fluid Power Division received a grant from the Houston Advanced Research Center for \$693,000.
- Will support the production of 12 trucks of Peterbilt Model 320 HLA's.
- Released in the 3rd quarter 2007.

HH Launch Assist cont.

- Must be sold and maintained in the State of Texas.
- Customers will be both municipal and industry.
 - City of Houston
 - City of Dallas
 - City of Denton
 - Waste Management
 - Allied Waste
 - Republic Waste